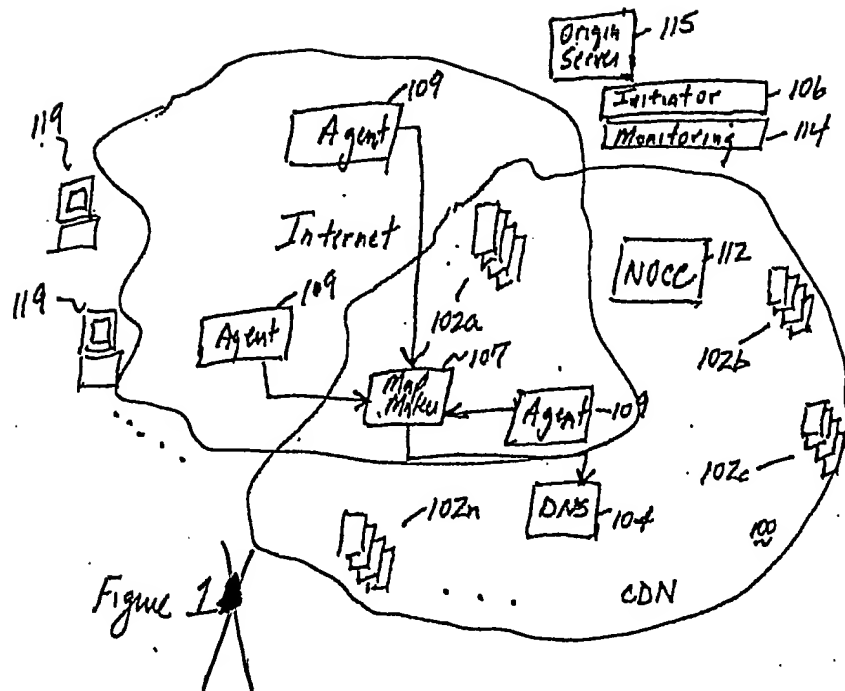


DRAWINGS TO BE DELETED FROM THE APPLICATION

Best Available Copy



X-deleted

Ghost in-box architecture

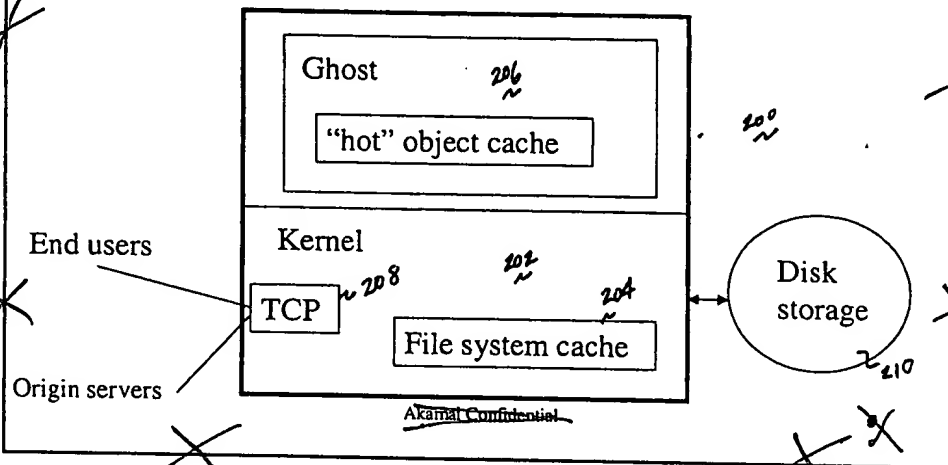


Figure 2

Region architecture

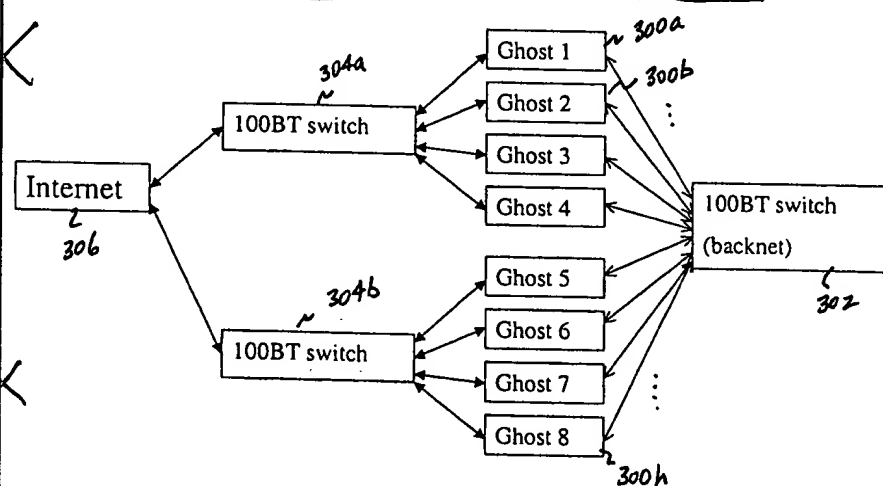
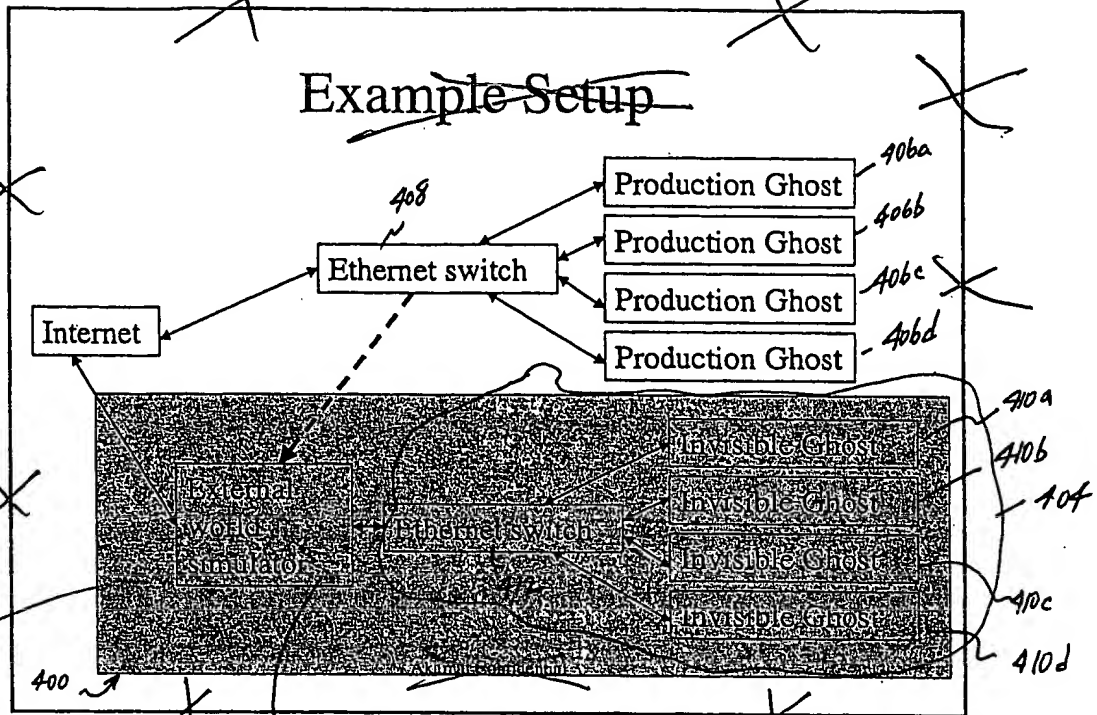


Figure 3

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Example Setup



Shading removed

Figure 4

Module Architecture

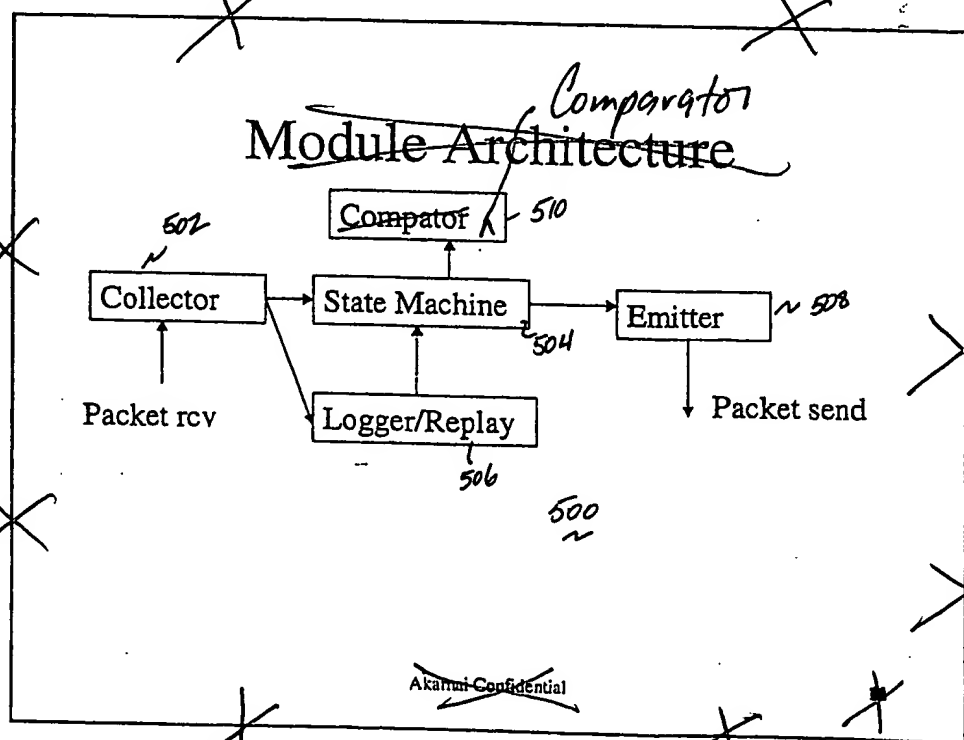


Figure 5

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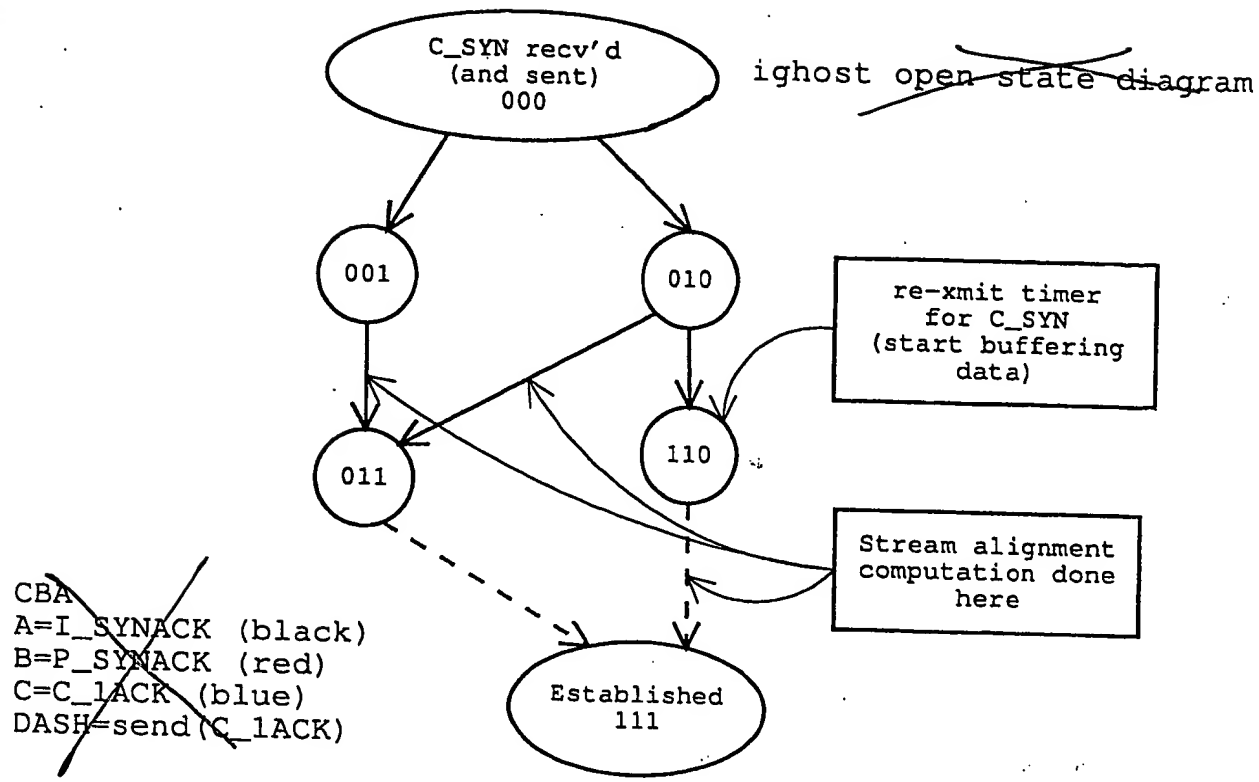


Figure 6

~~One connection in detail~~

Client - PG conversation

```

35.307723 client.2894 > PG.80: S 649812829:649812829(0) win 8192 id 37968
<mss 536>
35.307807 PG.80 > client.2894: S 2103996938:2103996938(0) ack 649812830
win 32736 id 22893 <mss 536>
35.394877 client.2894 > PG.80: . ack 1 win 8576 id 37989
35.402592 client.2894 > PG.80: P 1:405(404) ack 1 win 8576 id 37991
35.404046 PG.80 > client.2894: P 1:160(159) ack 405 win 32736 id 22902
35.404327 PG.80 > client.2894: F 160:160(0) ack 405 win 32736 id 22903
35.499080 client.2894 > PG.80: . ack 161 win 8417 id 38023
35.598546 client.2894 > PG.80: F 405:405(0) ack 161 win 8576 id 38049
35.598617 PG.80 > client.2894: . ack 406 win 32735 id 22925
    
```

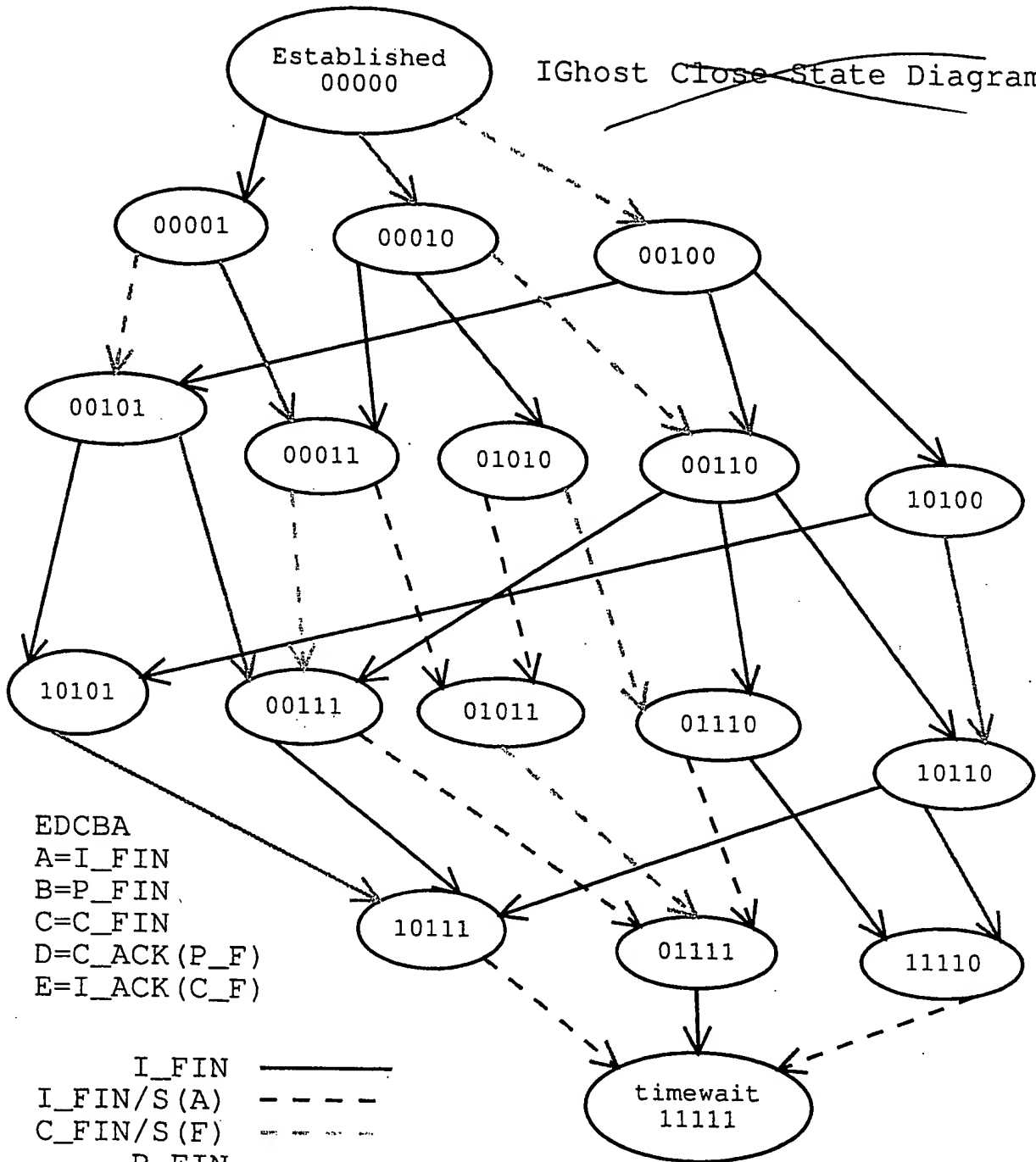
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Figure 8

5/8

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IGhost Close State Diagram



EDCBA
A=I_FIN
B=P_FIN
C=C_FIN
D=C_ACK(P_F)
E=I_ACK(C_F)

| | |
|------------|-------|
| I_FIN | ———— |
| I_FIN/S(A) | ----- |
| C_FIN/S(F) | ----- |
| P_FIN | ———— |
| C_ACK | ———— |
| C_ACK/S(A) | ----- |
| I_ACK | ———— |

Figure 7

~~W/IG: connection open~~

35.307723 client.2894 > PG.80: S 649812829:649812829(0) win 8192 id 37968
<mss 536>

EWS duplicates client open

35.307864 client.2894 > IG.80: S 649812829:649812829(0) win 8192 id 37968
<mss 536> (ews)

35.307807 PG.80 > client.2894: S 2103996938:2103996938(0) ack 649812830
win 32736 id 22893 <mss 536>

Invisible Ghost responds to open

35.308005 IG.80 > client.2894: S 1396028487:1396028487(0) ack 649812830
win 32736 id 44202 <mss 536>

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Figure 9

~~W/IG: 1st ack and request~~

35.394877 client.2894 > PG.80: . ack 1 win 8576 id 37989

EWS duplicates client first ack, adjusting sequence numbers

35.394940 client.2894 > IG.80: . ack 1 win 8576 id 3750 (ews)

35.402592 client.2894 > PG.80: P 1:405(404) ack 1 win 8576 id 37991

EWS duplicates client request

35.402723 client.2894 > IG.80: P 1:405(404) ack 1 win 8576 id 37991 (ews)

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Figure 10

~~W/IG: Ghost responses~~

Invisible Ghost responds with 196 bytes
35.404068 IG.80 > client.2894: P 1:197(196) ack 405 win 32736 id 44209

Production Ghost with 159 bytes
35.404046 PG.80 > client.2894: P 1:160(159) ack 405 win 32736 id 22902

PG closes connection
35.404327 PG.80 > client.2894: F 160:160(0) ack 405 win 32736 id 22903

IG closes connection
35.404457 IG.80 > client.2894: F 197:197(0) ack 405 win 32736 id 44210

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Figure 11

~~W/IG: Ack generation~~

Client acknowledges data & FIN
35.499080 client.2894 > PG.80: . ack 161 win 8417 id 38023

EWS ack's data (rounding to packet boundary)
35.499146 client.2894 > IG.80: . ack 197 win 8381 id 3776 (ews)

EWS ack's FIN (blowing window open for drain)
35.540786 client.2894 > IG.80: . ack 198 win 65533 id 3778 (ews)

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Figure 12

~~W/IG: Connection Close~~

35.598546 client.2894 > PG.80: F 405:405(0) ack 161 win 8576 id 38049

35.598604 client.2894 > IG.80: F 405:405(0) ack 198 win 8576 id 38049 (ews)

35.598617 PG.80 > client.2894: . ack 406 win 32735 id 22925

35.598754 IG.80 > client.2894: . ack 406 win 32735 id 44216

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Figure 13

~~Compartor Report~~

```
[[cmp start Wed Jun 12 04:44:14 2000]]
[ui (38.168.66.2:1283) headers (request 1)]
GET /7/1508/993/3826768/www.looksmart.com/1/s99/1s-cuts.gif HTTP/1.0
Accept: */*
Referer: http://www.looksmart.com/eus1/eus65300/eus65303/cus77824/eus65079/cus327765/eus327766/eus318905/eus318610r?1;
Accept-Language: en-us
Accept-Encoding: gzip, deflate
User-Agent: Mozilla/4.0 (compatible; MSIE 4.01; Windows 95)
Host: o1508.g.akamai.net
[pg (38.187.87.201:80) headers (1) total_bytes: 1982 body_bytes: 1735]
HTTP/1.0 200 OK
Date: Fri, 12 Nov 1999 01:57:01 GMT
Server: Apache/1.3.4 (Unix)
Last-Modified: Mon, 09 Aug 1999 22:03:59 GMT
ETag: "a9c711-6c7-37af504f"
Accept-Ranges: bytes
Content-Length: 1735
Content-Type: image/gif
Connection: close
[ig (38.185.125.201:80) headers (1) total_bytes: 1903 body_bytes: 1656]
HTTP/1.0 200 OK
Date: Wed, 12 Jun 2000 02:15:14 GMT
Server: Apache/1.3.4 (Unix)
Last-Modified: Wed, 11 Aug 1999 20:02:14 GMT
ETag: "7a939-678-37b1d6c6"
Accept-Ranges: bytes
Content-Length: 1656
Content-Type: image/gif
Connection: close
[msg] Differing response lengths
[[cmp end]]
```

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Figure 14